MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

TCS 2241 – COMPUTATIONAL SCIENCE

(All sections / Groups)

17 MARCH 2018
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages (excluding cover page) with 5 Questions.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided

Question 1

(a) The Classic Lamp shop sells one-bulb-lamps. It sells two types of one-bulb-lamps which are authentic lamps and contemporary lamps. An authentic lamp with a canvas shade takes 1.5 hours to make, while a contemporary lamp with a plastic shade requires 60 minutes to make. An authentic lamp sells for a profit of RM35, and a contemporary lamp sells for a profit of RM20. In the next month, the Classic Lamp shop has 50 bulbs and 35 canvas shades and 50 plastic shades and 60 hours of manufacturing available. The Classic Lamp shop wishes to determine a maximum profit production plan assuming that everything produced can be sold. Formulate a Linear Programming model for this problem. Define the decision variables, objective function and constraints that fulfils this problem.

[3.5 marks]

(b) Consider the following Linear Programming problem:

Minimize $Z = x_1 - 3x_2 + 2x_3$

Subject to

$x_1 + 4x_2 - 2x_3 \geq 6$

$3x_1 + x_2 + 2x_3 \geq 9$

$x_1, x_2, x_3 \geq 0$

(i) Convert the Linear Programming into a maximization problem. Then, express it in a standard equation format.

[2 marks]

(ii) Create the initial simplex table based on (i).

[1.5 marks]

(iii) You are still not able to solve the problem directly using b(ii). Why? Please explain and show a new table.

[3 marks]

Continued .....

Question 2

(a) There are 3 types of special cases in Linear Programming (LP), which are

Case 1: having alternative or multiple optimal solutions.
Case 2: having infeasible solutions.
Case 3: having unbounded solutions.

Using graphs, identify which case applies to the following LP problems.
[3 + 3 = 6 marks]

(i) Minimize $Z = 200x_1 + 300x_2$
subject to
$2x_1 + 3x_2 \geq 1200$
$x_1 + x_2 \leq 400$
$2x_1 + 1.5x_2 \geq 900$
$x_1, x_2 \geq 0$

(ii) Maximize $Z = 4x_1 + x_2$
subject to
$8x_1 + 2x_2 \leq 16$
$5x_1 + 2x_2 \leq 12$
$x_1, x_2 \geq 0$

(b) Linear programming is an application of matrix algebra used to solve a broad class of problems that can be represented by a system of linear equations. Two of the commonly used approaches to solve the LP problems are simplex and graphical methods.

(i) Explain the ONE (1) limitation and ONE (1) advantage of graphical method.
[2 marks]

(ii) When do you needs to use simplex method to solve a real-world LP problem? Give an example of LP problem to support your opinion.
[2 marks]

Continued .....

Question 3

(a) Table below shows the balanced quantity of supply and demand for 3 sources and 4 destinations, associated with their respective transportation cost. Use Northwest-corner method and Vogel approximation method to find the initial cost. Which method provides the most minimum initial cost?

[4 marks]

Source	Destination				Supply
	1	2	3	4	
A	4	3	8	7	RM 550
B	7	6	2	3	RM 600
C	2	6	4	5	RM 300
Demand	RM 650	RM 400	RM 200	RM 200	

(b) The following table is part of the solution in solving a transportation problem, where non-basic variables are indicated in brackets (,). Please complete the table parts: **(i), (ii), (iii), (iv), (v) and (vi)**. Determine whether this table achieves the optimal solution.

[3 marks]

	$v_1 = 3$	$v_2 =$ **(i)**	$v_3 =$ **(iii)**	$v_4 =$ **(iv)**
$u_1 = 0$	3 | 350	2 | 150	7 | **(v)**	6 | (-6)
$u_2 =$ **(ii)**	7	5 | 250	2 | 200	3 | 150
$u_3 = -1$	2 | 250	5 | (-4)	4 | (-6)	5 | **(vi)**

(c) John pays his subcontractors a fixed fee plus mileage for work performed. On a given day the contractor is faced with three electrical jobs associated with various projects. Given below are the distances between the subcontractors and the projects. How should John assigns 3 projects to 4 subcontractors to minimize the total cost with Hungarian method?

[3 marks]

Subcontractor	Projects		
	A	B	C
1	50	36	16
2	28	30	18
3	35	32	20
4	25	25	14

Continued .....

Question 4

(a) An event organizer company is in a process of preparing a schedule of activities for a rock concert. The following table provides the associated activities.

Activity	Description	Predecessor(s)	Duration (days)
A	Find site	-	3
B	Find engineers	A	2
C	Hire opening act	A	6
D	Set radio and TV ads	C	2
E	Set up ticket agents	A	3
F	Prepare electronics	B	3
G	Print advertising	C	4
H	Set up transportation	C	1
I	Rehearsals	F,H	2
J	Last-minute details	I	2

(i) Illustrate the project network diagram.

(ii) Determine the earliest and latest event times for each activity in a(i).

[2 + 2 = 4 marks]

(b) Consider the following iteration matrices, D_3 and S_3 from Floyd's algorithm.

D_3

	A	B	C	D
A	-	10	2	3
B	∞	-	5	∞
C	6	16	-	9
D	∞	7	12	-

S_3

	A	B	C	D
A	-	B	C	D
B	A	-	C	D
C	A	A	-	A
D	A	B	B	-

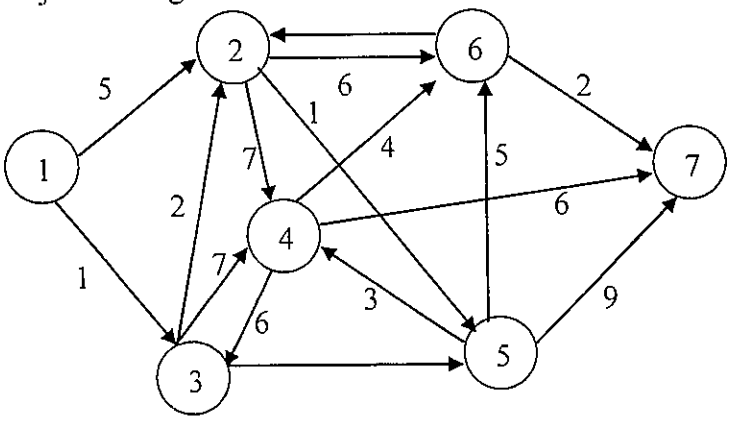
(i) Create the final iteration matrices, D_4 and S_4 by using $d_{ik} + d_{kj} < d_{ij}$.

(ii) Refer to D_4 and S_4, determine the shortest path between A to D and D to A.

[2 + 1 = 3 marks]

(c) The network diagram shows the distance (in km) between retail shops in City A. Peter is a sales representative and he would like to travel from shop 1 to shop 7 to deliver the goods. Use Dijkstra's algorithm to find the shortest route and distance between these 2 shops.

[3 marks]



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Question 5

(a) VectorTech Sdn. Bhd. supplies tyre pressure sensor chips to an automobile factory. One of the components has an annual demand of 700 units and this is constant throughout the year. The ordering cost is RM6 per order and the holding cost is about RM0.8 per unit per year.

(i) What is the optimum order quantity in order to minimize cost and how many orders per year are needed with the optimal policy?

[2 marks]

(ii) Suppose the holding cost is not RM0.8 per unit per year and VectorTech Sdn. Bhd. has been ordering 50 units each time an order is placed. For this order policy to be optimal, find out the holding cost.

[1 mark]

(b) Given the following non-linear programming problem.

$$\textbf{Maximize } Z = 4x_1 - x_1^2 + 8x_2 - x_2^2$$
$$\textbf{Subject to: } x_1 + x_2 \leq 2$$
$$x_1, x_2 \geq 0$$

(i) Decide which method do you need to use to solve the problem. Why?

[1 mark]

(ii) Solve the problem using the method that you suggested in (i).

[6 marks]

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